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Team project work for distance learners in engineering – challenges and benefits

Mark Endean, George Weidmann, Alun Armstrong, Jim Moffatt, Tony Nixon and Bob Reuben

Abstract

Team Engineering (first presented in autumn 2006) was the first course (module) at the Open University (OU) to use wikis and video-conferencing in combination to support the work of project teams. Teams of five students, working remotely from one another, tackle an engineering project over 32 weeks.

The teams schedule regular meetings throughout the project and these are conducted using FlashMeeting, a lightweight video-conferencing system being developed by the OU's Knowledge Media Institute, KMi (<http://flashmeeting.open.ac.uk>). Unlike other systems, FlashMeeting requires no software installation. In addition, it not only archives the meetings but also provides detailed analysis of the proceedings.

The teams are encouraged to use the wiki facility in the OU's virtual learning environment (VLE) for their collaborative report-writing. The collective work of the team is assessed through these reports. The performance of the individual is assessed through their reflective account of the project. The archiving facility in FlashMeeting has been of huge help in developing this. For the next presentation of the course a learning journal is to be added to the existing means of support.

Feedback from tutors and students alike has been extremely positive, whilst recognising the limitations of the technologies in their current implementations. This paper gives an account of the students' achievements and offers an assessment of the pedagogic potential of using these media together.

Introduction

Team Engineering is the compulsory final course in programmes of study leading to the OU's Integrated Masters Degree in Engineering (MEng) and Postgraduate Diploma in Engineering qualifications. Entry to *Team Engineering* is only open to students who have completed all the other components of their programme, so this will always be the final course a student undertakes in order to complete their qualification. For both qualifications, these components include optional study selected from postgraduate courses in technology, computing, mathematics and science, plus a professional development planning course. In addition, the integrated MEng requires students to have completed an engineering honours degree not more than three years previously.

Team-working is common to almost all national standards for the education of engineers. However the challenges facing distance learners working in teams are substantial. *Team Engineering* was developed in order to give OU engineering students a formal opportunity to work with fellow students on engineering projects in teams with between four and seven members. We set out to develop a course that delivered the following key skills learning outcomes.

On completion of the course, students will have demonstrated their ability to:

- communicate effectively, both orally and in writing, with other group members during the project and in the presentation of the individual and group outcomes of the project
- develop, monitor and continually update a plan for personal contribution to the group project
- negotiate, adopt, review and comment critically on the personal role taken within the group and exercise leadership within that role
- work effectively, in a variety of roles, as part of a team, exercising independence and leadership when appropriate.

A great deal has been written on the formation of teams, team dynamics and working in teams, of which all aspects can present difficulties even in a face-to-face environment. But it is at the first stage – team formation – that teams of distance learners most often founder. In many instances distance learners are allowed to complete a module regardless of whether or not they are an effective operational member of a team. However, *Team Engineering* is the only opportunity within the postgraduate engineering programme for students to demonstrate these outcomes. Students would therefore be unable to complete the course satisfactorily without being part of a team. If any group were to ‘fail’ as *a team*, the students would fail with it.

The course team thus felt that it was important to provide as cohesive an environment as possible for the teams. One element of this was student participation and choice in the formation of teams – this would help establish and maintain a team ethos by giving students ‘ownership’ of the resulting group. It was apparent that this was difficult, if not impossible, to achieve at a distance, particularly within a realistic time frame. The most viable way of getting students to form themselves into teams was by face-to-face contact and interaction, hence the requirement at the beginning of the course for a residential weekend. Students help (and are helped) to form their project teams during the early stages of this weekend as an integral part of a process which also selects one of the engineering projects on offer and allocates the team its tutor.

Having invested significant time and effort in becoming a member of a particular team, and having formed personal relationships with the other team members, each student leaves the first residential weekend with a real commitment to the success of the team. They undertake to participate fully in all of the team processes. The course team undertakes to provide them with information and communication technology (ICT) support that makes their task as straightforward as possible. In addition to the ‘standard’ kit of FirstClass and normal telephony, we chose two particular tools: the wiki facility in the VLE and FlashMeeting. This paper details the students’ experience with each of these and then reviews their responses to these aspects of the course and the course as a whole.

FlashMeeting

The *Team Engineering* course team felt it important to keep the students’ team-working, as far as practicable, within the OU domain in order to avoid the chaos of ‘small pieces’ (Sclater, 2007). In reviewing the various options for synchronous communication to support their work, the developing FlashMeeting system had the potential to make a valuable contribution to the toolbox for the students to use. In particular:

- its reliance on installation of nothing more than a Flash plugin, which is generally already installed on most personal computers

- the simple hardware and network requirements – a cheap webcam and a dialup connection work adequately, although a broadband connection is preferable
- the provision of one-to-many voice and video channels
- no single ‘point of control’, allowing all participants equal status within a meeting
- the emoticons - voting and ‘agree/disagree’ icons which allow participants to express their views simultaneously and in real time
- the text chat facility.

What we did not see at the outset was the enormous potential offered by the recording facilities built into FlashMeeting. These are discussed in more detail below.

At the first residential weekend each student was given a webcam and a short briefing on how to set up and use FlashMeeting. Each team nominated one or more members to take responsibility for booking the meetings and returned home from the weekend with their first meeting already booked. From then on the course team had no further involvement in how the teams used the facility.

According to the students themselves, FlashMeeting was in regular use by them throughout the course. One of the teams quickly established a protocol of twice-weekly meetings – one informal ‘common room’ type meeting and one formal meeting with an agenda and minutes. The other experienced some technical problems early on (two team members lived in Greece and one relied on a dialup network connection) and they came to rely less on the video conferencing abilities of the system. This second team learned to make use of a wider variety of communication methods but, nevertheless, still had regular FlashMeetings even if less frequently than the first team.


The students’ continued use of the software is testament enough to its success in supporting their work. The minor technical shortcomings did little to dampen their enthusiasm for synchronous, face-to-face meetings:

It’s really good just to see everyone’s faces. You see George [one of the Greek students] light a cigarette or someone else leaves the room and comes back again. It feels like you’re all together in the same place.

The software encourages efficient meetings without stifling freedom of expression. And, crucially, the meetings are recorded to be referred back to later. This final feature adds a hugely important extra dimension to the usefulness of FlashMeeting in an educational context.

Following the end of a meeting, the original meeting URL links through to the FlashMeeting archive (Figure 1). From there can be accessed a straightforward replay of the meeting with some very useful navigation tools (Figure 2) and a page of ‘minutes’ (Figure 3). These include a copy of the text chat from the meeting and a ‘visualiser’ or event map (Figure 4).

Figure 1. FlashMeeting archive screen dump




Meeting Details

[Main](#) | [Help](#)

T885 Blue Group


Third meeting




Date and Time

Wed, 25 Oct 2006 20:00:00 +0100

The meeting lasted 59 minutes



[Go to the replay](#)



[Go to the minutes](#)

Replay Viewed

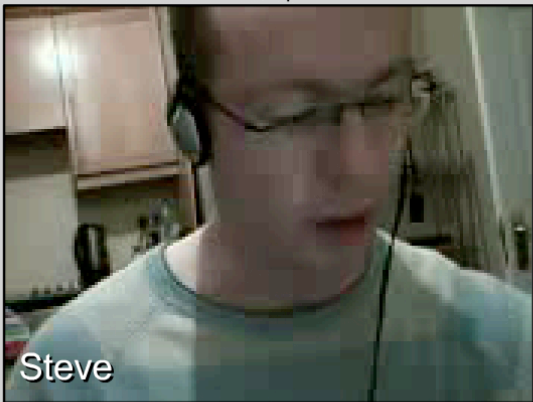
20 times

XML

Figure 2. Meeting replay screen

25-10-06 T885 Blue Group

⚡
snaps
files
urls
chat
list



Steve

16:30	Steve
16:41	John
16:50	Steve
17:01	John
17:09	Steve
18:22	Mark
18:49	Steve
19:14	John
19:22	Steve
20:11	Mark
20:30	Bob
20:57	Mark
21:06	Steve

⏮
⏪
⏩
⏭

see URLs
open snaps

00:17:09
◀ 00:15
58:57 ▶

Steve	<div style="background-color: blue; width: 100%; height: 5px;"></div>
Bob	<div style="background-color: red; width: 100%; height: 5px;"></div>
Mark	<div style="background-color: purple; width: 100%; height: 5px;"></div>
Bryn	<div style="background-color: orange; width: 100%; height: 5px;"></div>
Jeff	<div style="background-color: green; width: 100%; height: 5px;"></div>
John	<div style="background-color: black; width: 100%; height: 5px;"></div>

Figure 3. Meeting minutes

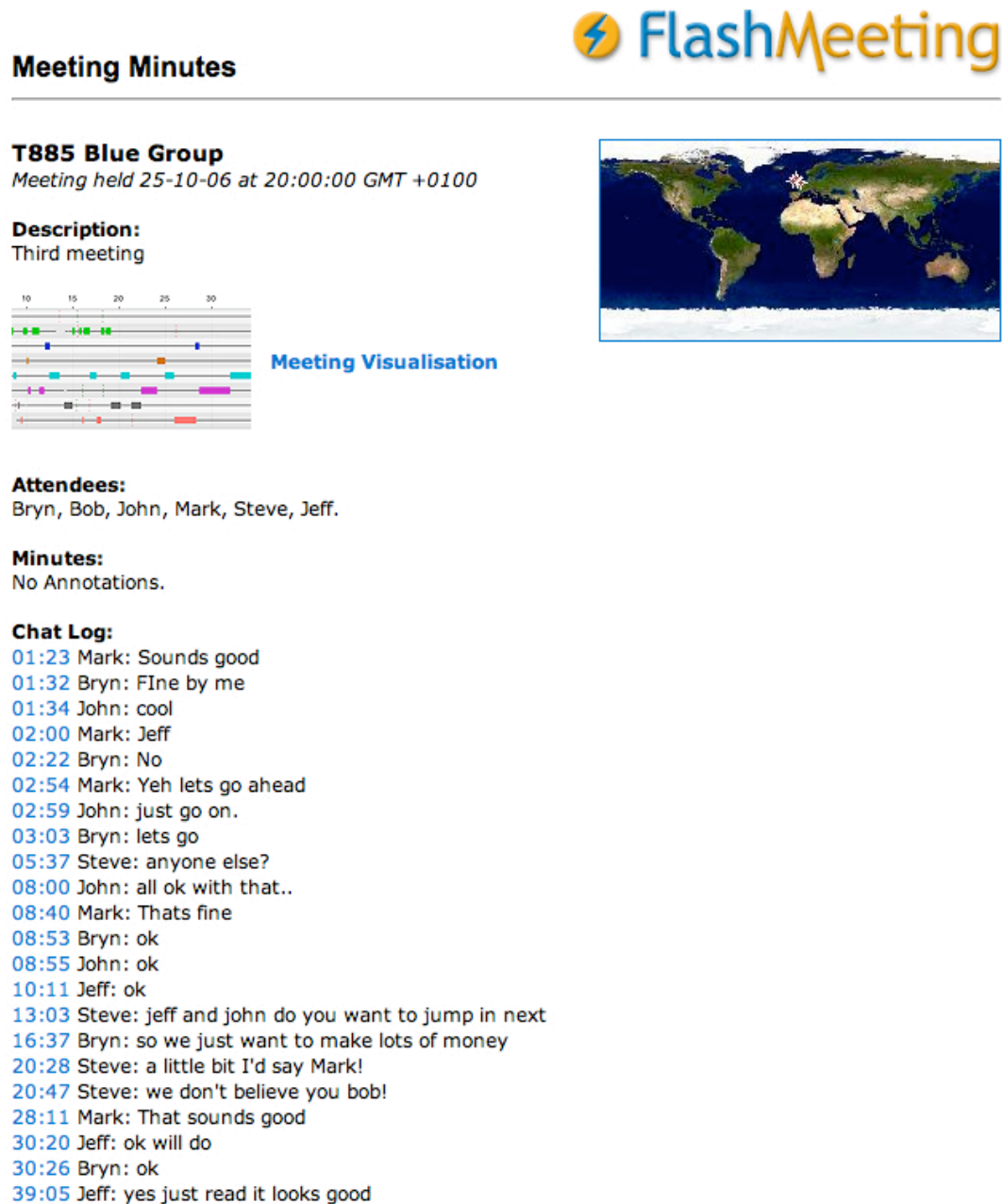
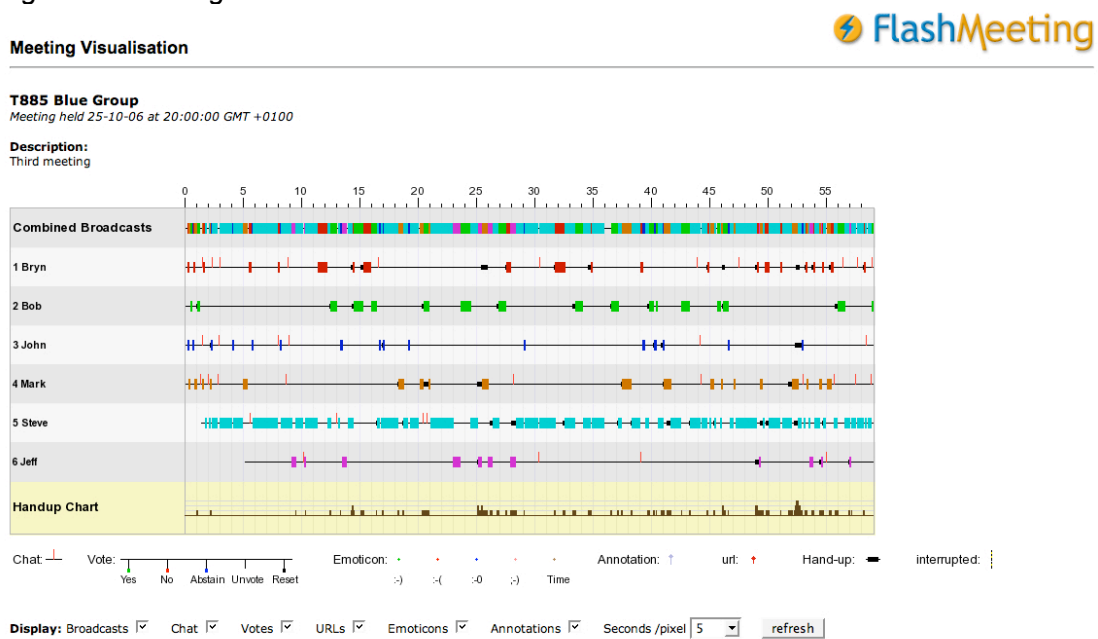


Figure 4. Meeting visualiser



VLE wikis

A wiki in its purest form is simply a webpage that anyone can edit at any time (see <http://en.wikipedia.org/wiki/Wiki>). With the added capability of restricting access to a wiki to specified people, any group of co-workers will find using a wiki a simple and straightforward way to produce reports and other documents to which several of them need to contribute. Indeed, this paper was co-authored in a wiki.

Wikis are growing rapidly in popularity in educational communities because of the potential they offer for collaborative learning. But that was not our concern for *Team Engineering*. All we wanted was somewhere that each student team could compile their work; a place where each of them could see what the others had been doing that was not tied to a particular computer or geographical location and that they had complete freedom to use in whatever fashion they found most beneficial.

Each team was allocated a wiki to which all members of the team and their tutor had access. In addition, we gave each student their own wiki that was restricted to them and their tutor alone. The course team also had access to all the wikis during this development phase so the students were aware that none of what they put in the wiki could be entirely 'confidential'. However, the principle was established that each team's work was not to be seen by other teams and each student's personal wiki was not to be seen by other students. All of the wikis were initially free of content or structure.

The teams used their wikis for a range of different purposes, including:

- meeting agendas
- meeting minutes
- project planning
- task allocations
- assignments
- assignment feedback (from the tutor)
- project journals.

Many of these uses do not require the inputs of more than one person, so it is interesting to see how the teams quickly started using the wiki space as a simple shared document repository.

In preparing longer documents, such as the team reports, the students encountered some technical difficulties, most notably:

- the very crude wiki implementation in the earliest versions of the VLE
- the incorporation of images into wiki pages
- the need to extract from the wiki the work that was to be submitted for assessment.

Being mature engineers, *Team Engineering* students are pragmatic people. They therefore found ways round these problems. But their 'workarounds' reduced their reliance on the wiki and they inevitably used it less than they would otherwise have done. All of these difficulties therefore need to be addressed in order for the wikis to deliver their full potential.

Student assessment

The effective alignment of assessment with learning outcomes and the learning activities a student engages in is the major key to a successful learning experience (see Biggs and Tang, 2007). Put simply, students focus their efforts on what rewards them most. The assessment for *Team Engineering* was designed with this firmly in mind.

In addition to the key skills learning outcomes listed earlier, *Team Engineering* students are also expected to demonstrate that they can:

- identify and apply appropriate quantitative and qualitative tools to elicit a client's needs and to create innovative solutions to those needs
- elicit and transform a set of customer requirements into a specification for an engineering system to meet an identified need
- collect, critically evaluate and use information from a wide variety of sources to generate a range of solutions to the problems defined, and identify and use suitable criteria to select a single solution for further development
- evaluate the outcomes of the project against the original needs using suitable social, environmental, ethical, economic and commercial measures of performance.

Both sets of learning outcomes are assessed through a combination of:

- team reports on the design and development task the team undertakes
- oral and poster presentations of the project at a residential event
- personal reflection by the student on their effectiveness as a member of the team
- the tutor's view of the contribution of the student to the functioning of the team.

Two important principles embedded in the assessment are that:

1. the efforts of the team (the second set of outcomes immediately above) are assessed as a team – individual contributions to what the team creates are not separately determined
2. the achievement of each team member (the earlier set of key skills outcomes) is assessed through their personal reflection on the team process and through their tutor's observations – team members do not individually submit project work for assessment.

The aim was to create an environment for learning that was both cooperative and reflective, whilst at the same time providing a means of differentiating the level of achievement of one student from another. Both the wikis and FlashMeeting made important contributions to these goals.

In this context, arguably the most important aspect of working in a wiki is that the status of all team members is equal. Each can contribute original material and each can edit and comment on the work of all other members. Since no attempt is made to distinguish the work of the individual when assessing the work of the team, any contribution is of equal value and there is no sense of competition between students, freeing them up to do the best they can for the team. At least, that was the starting premise.

FlashMeeting, on the other hand, would simply be another communication tool were it not for the extensive and highly sophisticated archiving facility shown in the illustrations above. These features provide an enormously rich resource for students to draw on during their reflections on the work of the team. As one student put it: *I've looked back at the recordings of meetings and thought: 'I could have handled that better' or 'I must make more of an effort to join in the discussion'.*

Tutors, too, can use the records of the meetings to help in the process of assessing each team member's efforts.

In the first year of presentation, students were assessed during the course of their study through the conventional tutor marked assignment (TMA) system that has been used by the OU for many years. Three assignments are submitted to the student's tutor (this is now done electronically) for marking and, equally importantly, formative feedback. This method of continuous assessment encourages students to keep abreast of their learning and ensures that any students that may be having difficulties are identified and receive additional tutor support. For a postgraduate module leading to a masters-level qualification it was anticipated that students would be sufficiently experienced and motivated not to require additional support. Moreover, it was felt that the team-working aspect of the course would ameliorate any problems that individual students might have. This proved to be the case and students working in their respective teams produced exemplary assignments.

Long-established OU assessment practice is to have both a continuous assessment process and an end-of-course assessment (ECA), such as an exam or project report, for all courses in a programme. *Team Engineering* was no different. However, every item submitted for assessment (each TMA and the ECA) was divided into two distinct parts. These parts were designed separately to:

1. examine the progress of the overall team project, starting with a project outline and culminating in a full report
2. encourage students to reflect on their own contributions to the performance of the team and how they considered other team members were contributing to the overall team activity through a set of structured questions given in the assignment.

Each component of the TMAs and ECA carried a different weighting which contributed to the final overall score by which the students' performance was measured for grading purposes. In addition, a threshold score for each assignment was identified. Each of these thresholds needed to be achieved before students could be awarded a pass grade which ensured that, to pass the course, a student had successfully and constructively contributed to the overall team dynamic.

Outcomes and feedback

It was fascinating to watch the teams and their projects developing over the weeks by regularly logging in to their wikis and monitoring the progress of their meetings and assignments. By the time of their presentations at the second residential weekend, we were confident that we would be getting mature and well-integrated products at a suitably postgraduate level. To help polish their presentation skills, we engaged a professional drama coach. Her effect was certainly dramatic! The teams' presentations were vastly superior to what would normally be expected of postgraduate students giving their first paper.

The final team project reports were also impressive pieces of work and amply demonstrated that five graduate engineers can achieve more by working as a team than as five individuals. In their overall performance, our ten students scored highly creditably. On a three-grade scale of pass-merit-distinction, they achieved six distinctions and four merits.

Overall as a course team we were extremely pleased with how the course worked in its first presentation. But what did the students think?

All courses offered by the OU are surveyed at the end of their first presentation using a very comprehensive set of tried-and-tested questions which cover everything from the quality of printed support material to the amount of time spent studying. *Team Engineering* was no exception and five of the initial cohort of ten students completed and returned the survey. The questions are scored using a five-point Likert scale ranging from very positive through neutral to very negative. The survey also includes some 'free-form' questions designed by the course team to elicit more verbose responses.

Table 1 summarises the findings from the key survey questions relating to a student's view of their experience. Clearly the small number of returns precludes any quantitative analysis of the data. However, allowing for neutral responses, it is clear that one student was less than satisfied with certain aspects of the course. In fact, the differences between students are much more marked than this table suggests. The question relating to the 'overall quality' of the course drew three very positive responses, one neutral and one very negative. The opinions of the students about what we had presented to them were therefore highly polarised.

Table 1. Selected survey results

Question	positive	neutral	negative
Stated learning outcomes met	3	1	1
Assessment allowed me to demonstrate my learning	5	0	0
Overall quality of experience	3	2	0
Overall quality of course	3	1	1
Overall enjoyment	3	2	0

To gain a clearer understanding of the causes of this dissatisfaction, we can draw on the free-form responses:

The 'team' element of assessment in t885 did not reflect each individual's input. I felt I did a lot more work than some team members.

One team member did not contribute much to the joint assignments but still got the same mark as the rest of the team. This seemed very very unfair. We didn't have the power to 'sack' the member from our team.

This points to an ever-present problem with teamwork in an academic context – the perception by one (or more) members of the team that another member is not pulling their weight, yet is still (unfairly) being awarded the same scores for assignments. Despite our best efforts, *Team Engineering* turned out not to be immune to this. However, it is very much a question of perception. The writer(s) of the comments above overlooked the sizeable proportion of the overall course mark that was awarded for the individual's performance, plus the tutor's assessment of the individual's contribution. Our response to this feedback from the first presentation is to strengthen the messages given to students about how we separate the various elements of assessment and about the responsibility they have towards each other to ensure a successful outcome for the team.

Apart from this single case, the combination of formal responses to the student survey, slightly less formal responses at the tutor debriefing meeting and informal messages from both students and tutors has been very largely positive. In particular the free-form request on the survey for those aspects of the course that students liked most, prompted the following three comments:

The video conference system works personally well. At last we were able to keep in contact with the group team working.

Working with other students and the video conferencing was [a] very good tool.

Team working webcam team meetings working through the project 'experience'. Having a lot more contact with other course students than normal.

For FlashMeeting to be what three separate students liked most about *Team Engineering* speaks volumes for the value placed by distance learning students on personal interaction. It also, we would argue, highlights a simple, cheap and efficient enhancement to any distance learning course where the students would benefit from working together.

In addition to feedback from students, what we have learned from the tutors has also been invaluable as an input to modifying some aspects of the course for the next presentation. Following their advice, the total number of tutor-marked assignments has been reduced by a third in order to eliminate some unnecessary repetition in assessment elements and to lessen the load on tutors. The number of students allocated to each tutor has also been decreased – from fifteen students (i.e. three teams) to one team (i.e. four to seven students) since there was a strong feeling that handling a single team and one project was a sufficiently challenging task at this level.

Finally, we have to learn from the somewhat patchy use of the wikis, particularly for preparing the actual team reports. Any facility of this sort, particularly one that is unfamiliar to the learner, will become well-used if it is either:

1. of immediate apparent benefit to the student
- or
2. simply presented as 'the way it is done'.

The latter proviso is easier to accomplish where, for example, the use of ICT tools is itself part of the learning process. This will never be the case with *Team Engineering*, although we can anticipate future students being more familiar with the growing array of such tools through exposure on other courses and in their private lives. For now,

though, our efforts have been concentrated on working with our technical support colleagues to improve the functionality of the wikis and their integration, especially into the University's assessment system.

Preliminary conclusions

In its first year of presentation *Team Engineering* provided students with an essential final part of their Integrated Masters degree. The course delivered a number of novel learning experiences, from Flash meetings to wikis, that were enthusiastically adopted by the majority of participating students. It was clear that by using these tools the student project teams found that their physical separation did not present a barrier to effective team-working and the interaction of students within teams resulted in a final project report that was far superior to that which five students working as individuals could have been expected to produce.

The feedback from student surveys, tutors and anecdotal evidence was overwhelmingly positive, confirming that the course had met its objectives and was highly regarded as an educational experience.

Our interim conclusions, given that there has only been one presentation with ten students working in two groups, are that:

- teamworking learning outcomes can be supported at a distance with geographically distributed students using inexpensive tools and a modicum of face-to-face interaction
- the recording capabilities of wikis and FlashMeeting, coupled with suitable assessment tasks, offer a transparent and auditable means of assessing students on both a team and individual basis
- despite clear indications that the course is team-based, some students remain dissatisfied with the element of group assessment.

The first two of these are matters for simple confirmation; the third is a great deal more challenging, and we expect to be able to make some interesting pedagogic observations as we build up a larger sample of individuals passing through the course.

This is a work in progress. Many of the ways in which *Team Engineering* was presented in its first year were novel and the combination of student support methods was entirely unique. The technologies described here will mature and students will become more familiar with them through exposure in other contexts. But for now much has still to be done to ensure that the students are provided with useful tools that facilitate their work rather than adding an extra burden to it. *Team Engineering* is now included in a JISC-funded project exploring the use of combinations of learning media by students in vocationally-oriented study programmes (JISC, 2008). The outcomes of this research, coupled with the course team's own observations and feedback from students and tutors from the current intake, will further influence subsequent presentations of the course.

One very important question that remains to be answered is whether students who are not able to meet in person can nevertheless form strong working relationships with others through a combination of collaboration tools similar to those used by the students on *Team Engineering*.

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Sclater, N. (2007) *Personal Learning Environments, Virtual Learning Environments and Formal Learning*. EDEN Annual conference, 13-16 June 2007, Naples, Italy.

Other sources of information

A recursive wiki link – the Wikipedia article on wikis: <http://en.wikipedia.org/wiki/Wiki>

The FlashMeeting website: <http://flashmeeting.open.ac.uk/>

A FlashMeeting url for playback: <http://flashmeeting.open.ac.uk/fm/dc56d7-5966>

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